Remarks

The above Amendments and these Remarks are in reply to the Office Action mailed October 24, 2002. In the office action, the drawings and specification were objected to. The specification has been amended accordingly which also obviate the need to correct the drawings.

The claims were also rejected as being obvious over Suzuki in view of various secondary references. Attached hereto is a declaration under 37 CRF 1.131 by the inventor which shows that the claimed invention was reduced to practice prior to the effective date of the primary reference. The submission of the declaration is to facilitate prosecution and is without prejudice to the later submission of arguments that the cited reference(s) do not render the invention obvious. Dates have been blankened from the declaration attachments as permitted under the MPEP.

Please note that the address of the attorney of record, the undersigned, has been changed and the change has been recorded at and acknowledged by the PTO.

The Commissioner is authorized to charge any underpayment or credit any overpayment to Deposit Account No. 06-1325 for any matter in connection with this response, including any fee for extension of time, which may be required.

Respectfully submitted,

Date: 24 Jan 03

By: ______________________

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APPENDIX

In the Specification:

Please amend the paragraph on Page 2, beginning at line 11 to read as follows:

Projection lithography is a powerful and essential tool for microelectronics processing and has supplanted proximity printing. "Long" or "soft" x-ray (a.k.a. Extreme UV) (wavelength range of 10 to 20 nm) are now a the forefront of research in efforts to achieve smaller transferred feature sizes. With projection photolithography, a reticle (or mask) is imaged through a reduction-projection (demagnifying) lens onto a wafer. Reticles for EUV projection lithography typically comprise a glass substrate coated with an EUV reflective material and an optical pattern fabricated from an EUV absorbing material covering portions of the reflective surface. In operation, EUV radiation from the illumination system (condenser) is projected toward the surface of the reticle and radiation is reflected from those areas of the reticle reflective surface which are exposed, i.e., not covered by the EUV absorbing material. The reflected radiation is [re-imagined] re-imaged to the wafer using a reflective optical system and the pattern from the reticle is effectively transcribed to the wafer.

Please amend the paragraph on Page 2, beginning at line 26 to read as follows:

A source of EUV radiation is the laser-produced plasma EUV source, which depends upon a high power, pulsed laser (e.g. yttrium aluminum garnet ("YAG") laser), or an excimer laser, delivering 500 to 1,000 watts of power to a 50 μm to 250 μm spot, thereby heating a source material to, for example, 250,000° C, to emit EUV radiation from the resulting plasma. Plasma sources are compact, and may be dedicated to a single production line so that malfunction does not close down the entire plant. A stepper employing a laser-produced plasma source is relatively inexpensive and could be housed in existing facilities. It is expected that EUV sources suitable for photolithography that provide bright, incoherent

EUV and that employ physics quite different from that of the laser-produced plasma source will be developed. One such source under development is the EUV discharge source.

Please amend the paragraph on Page 3, beginning at line 8 to read as follows:

EUV lithography machines for producing integrated circuit components are described for example in [Tichenor, et al.] U.S. Patent No. 6,031,598 to Tichenor, et al. Referring to Figure 4, the EUV lithography machine comprises a main vacuum or projection chamber 2 and a source vacuum chamber 4. Source chamber 4 is connected to main chamber 2 through an airlock valve (not shown) which permits either chamber to be accessed without venting or contaminating the environment of the other chamber. Typically, a laser beam 30 is directed by turning mirror 32 into the source chamber 4. A high density gas, such as xenon, is injected into the plasma generator 36 through gas supply 34 and the interaction of the laser beam 30, and gas supply 34 creates a plasma giving off the illumination used in EUV lithography. The EUV radiation 40 is collected by segmented collector 38, that collects about 30% of the available EUV light, and directed toward the pupil optics 42. The pupil optics consists of long narrow mirrors arranged to focus the rays from the collector at grazing angles onto an imaging mirror 43 that redirects the illumination beam through filter/window 44. Filter 44 passes only the desired EUV wavelengths and excludes scattered laser beam light in chamber 4. The illumination beam 45 is then reflected from the relay optics 46, another grazing angle mirror, and then illuminates the pattern on the reticle 48. Mirrors 38, 42, 43, and 46 together comprise the complete illumination system or condenser. The reflected pattern from the reticle 48 then passes through the projection optics 50 which reduces the image size to that desired for printing on the wafer. After exiting the projection optics 50, the beam passes through vacuum window 52. The beam then prints its pattern on wafer 54.

Please amend the paragraph on Page 5, beginning at line 8 to read as follows:

As EUV lithography technology matures, more lithographic printing stations will be required for resist and process development. Proliferation of these systems has, however, been slowed by the lack of

reliable and cost-effective EUV sources. It would be greatly desirable to alleviate the dearth of EUV sources for lithographic process development applications in the form of small-field static microsteppers through the use of synchrotron radiation. The relatively high coherence of these sources, however, has precluded them from being used more extensively for actual lithography studies. Relevant process development applications require much more incoherence than is inherently provided by synchrotron sources. This is especially true of undulator sources that otherwise would be highly desirable for their large EUV power capabilities.

Please amend the paragraph on Page 9, beginning at line 28 to read as follows:

These problems can be overcome by utilizing reflection grating instead of transmission gratings. Again the underlying reflection grating can take on various forms, for example, binary amplitude or phase gratings as well as blazed phase gratings. Again, the advantage of using phase gratings, especially blazed phase gratings is the tremendous improvement in diffraction efficiency. Preferred blazed phase devices are quantized to between 3 and 8 levels. Fabrication of the reflective phase grating could be achieved, for example, by methods described in Naulleau, "Method of Fabricating Reflection Mode EUV Diffraction Elements", U.S. Patent Application Serial No. 09/730,970, filed December 5, 2000, now U.S. Patent No. 6,392,792, published May 21, 2002, and Anderson, et al. "Method of Fabricating Reflection-Mode EUV Diffusers", U.S. Patent Application Serial No. 09/846,150, filed April 30, 2001, which are incorporated herein by reference. As noted above, the random phase characteristics imparted by the holographic diffuser only manifest in the diffracted orders, thus, diffraction efficiency of the carrier grating is of utmost importance. Figure 3 illustrates a typical random phase modulated grating (holographic diffuser). In the case of a reflection phase carrier grating, black and white regions would represent two different heights, respectively, leading to a relative phase shift of pi between the two regions. For example, at the EUV wavelength of 14 nm and near-normal use, the height difference would be approximately 3.5 nm.

Please amend the paragraph on Page 12, beginning at line 24 to read as follows:

In the case of a "critical" illumination system as shown in Figure 1, spherical relay mirror 18 is an imaging mirror that re-images the holographic diffuser 10 onto reticle 70 which is mounted on reticle stage 68. From the reticle, the reflected pattern is focused by projection optics 60, 62 onto the surface of wafer 64, which is mounted on wafer stage 66. The projection optics can comprise a lithographic optic, which is known in the art. Suitable lithographic optics are described in [Hudyma, et al.] U.S. Patents 6,226,346, 6,188,513, 6,072,852 and 6,033,079 <u>to Hudyma, et al.</u> which are incorporated herein by reference.